
The following was presented at DMT'11
(May 22-25, 2011).

The contents are provisional and will be
superseded by a paper in the
DMT'11 Proceedings.

See also earlier Proceedings (1997-2010)
http://ngmdb.usgs.gov/info/dmt/

# REPLACING THE USGS TOPOGRAPHIC QUADRANGLE - BASEMAP ALTERNATIVE FOR GEOLOGIC MAPS

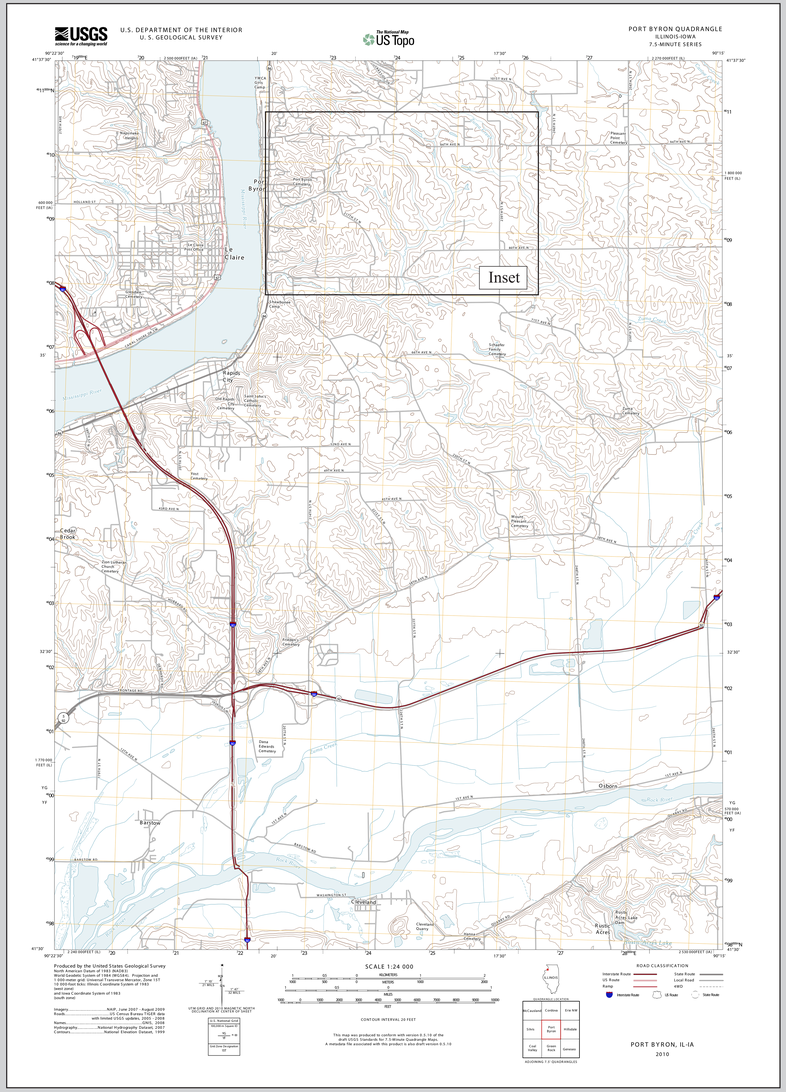
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
http://isgs.illinois.edu/

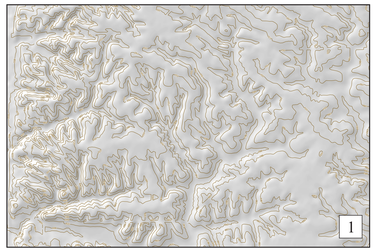
**Jane Johnshoy Domier and Donald E. Luman**

### US Topo

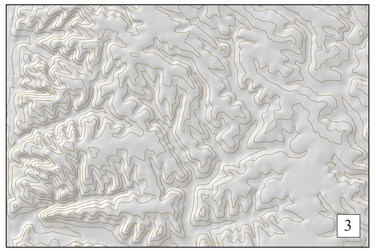
For the past 125 years USGS has produced topographic quadrangle maps which have served as the base for geologic mapping applications. In 2009, the USGS introduced the replacement for the lithographic printed 1:24,000 scale topographic map — the US Topo. US Topo maps have a much different appearance and exhibit reduced feature information from traditional USGS topographic quadrangle maps. Data layers include contours, roads, geographic names, hydrographic features, and an imagery base; additional layers will eventually be added including expanded transportation, boundaries, structures, and land cover feature information. As of mid-May 2011, nearly 27,000 US Topo maps for all or portions of 23 states are now available on the USGS Map Store.

Because topographic information is a critical input to geologic mapping, it is important to understand the changes to the contour data layer represented on the US Topo maps as compared to the original USGS quadrangle maps. The accuracy and content of the topographic information contained on US Topo maps is wholly dependent upon the quality of the elevation data contained within the USGS National Elevation Dataset (NED), which is variable across the United States. A mixture of mostly one-third arc-second DEM data (nominal post spacing of 10 meters), and lesser amounts of one arc-second DEM (NPS of 30 meters) and one-ninth arc-second DEM (NPS of 3 meters) data are used from the NED as the source for the US Topo contours. The majority of one-ninth arc-second NED elevation information is produced from Lidar (light detection and ranging) technology. Lidar-derived elevation data provides far more current, accurate and detailed topographic information than has been used for the historical 7.5-minute topographic quadrangles, which are the dominant source for the NED. Lidar data sets give us the opportunity to test NED data against a topographic model that is for all practical purposes, correct.

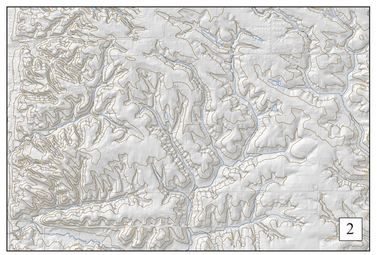


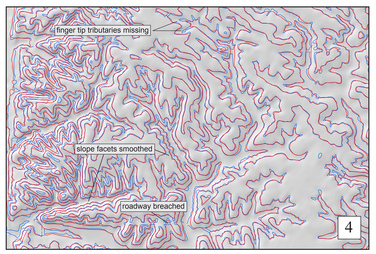

USGS 1:24,000-scale Hypsography Digital Line Graph (DLG) produced from scanning and conversion of the contour mylar feature separate for the 1991 USGS 7.5-minute Port Byron, IL-IA Quadrangle. Original contours were produced from photogrammetric compilation of 1986 aerial photography. Base image is shaded relief image produced from USGS National Elevation Dataset (NED) one arc-second DEM data. Contours from the original 7.5-minute topographic quadrangle maps were the source for the production of much of the NED DEM data.




The topographic information on the US Topo maps is produced by direct generation of contours from the NED one-third arc-second DEM data. The process of interpolating a digital elevation model from contour data and then extracting contours from that DEM necessarily degrades the accuracy and detail of the original contour data. When the US Topo contours are compared to the original source contours from which the NED was generated (Inset 1), it can be seen that important landscape feature detail has been lost.

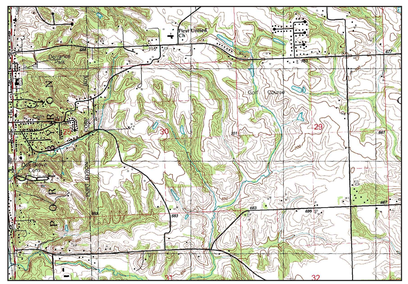



Cartographic contours produced from source 2009 Lidar 1.2 meter resolution DEM data resampled to a one arc-second nominal point spacing (30 meters). The original photogrammetric-based contours in Inset 1 compare favorably to the contours generated from the resampled Lidar DEM. Base image is a shaded relief image produced from the one arc-second Lidar DEM. Despite the significant downsampling of the original Lidar DEM from 1.2 m to 30 m, note the greater landscape feature detail as compared to the one arc-second DEM shown in Inset 1.



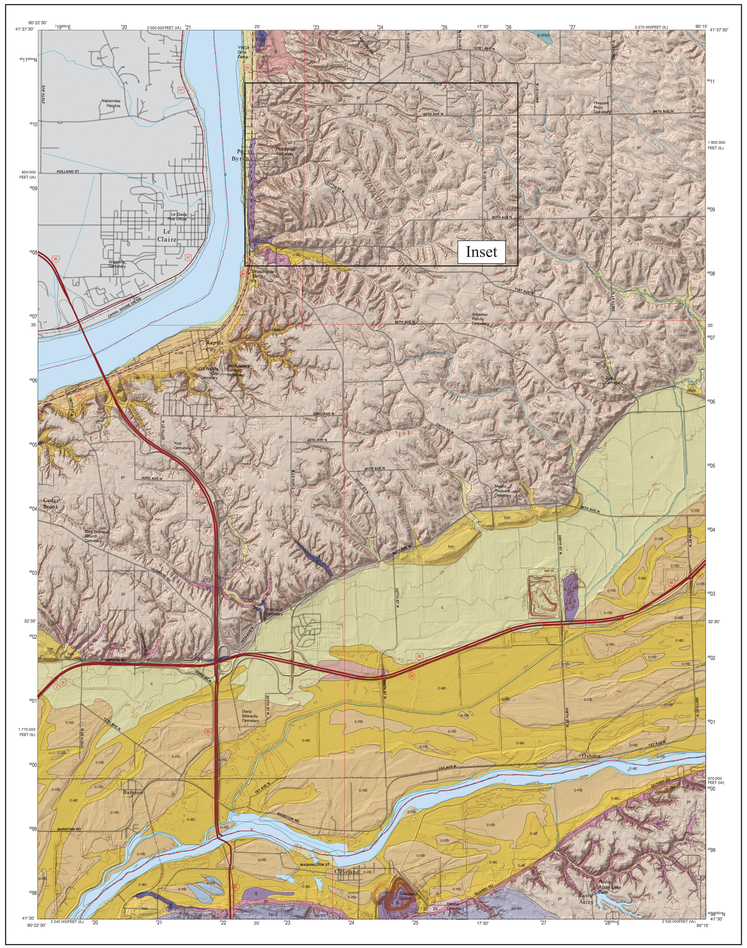

Comparison of US Topo contours (red) and DLG Hypsography contours (blue). This better illustrates how interpolating contours directly from DEMs alters the landscape feature detail. Many finger-tip tributaries are missing, slope facets are smoothed, resulting in a geometrically smoothed landscape surface. The resolution of topographic features that are often critical to the interpretation of geologic features has been substantially reduced.

## Basemap Alternative



1991 USGS 7.5-minute Port Byron IL-IA Quadrangle


2009 TIGER-Lidar-NHD Basemap




For decades USGS topographic quadrangle maps have been used by geologists as the base for geologic mapping applications. USGS topographic maps have historically provided consistently high quality map data and symbolization. A variety of derived products have been created from these topographic quadrangle maps, including greenline sheets, scans of the paper maps, Digital Raster Graphics (DRG), Digital Line Graphs (DLG), and Raster Feature Separates (RFS).

Since USGS ceased update and revision of the paper topographic maps, the currency for many geographic areas has become unacceptable. 'Provisional Edition' USGS maps created with metric contours have not been updated to be consistent with the standard contours in feet. DLG feature layers were never completed for many states, 1st generation DRGs are too coarse in resolution, 2nd generation DRGs were never completed nationwide, and RFS products are no longer produced by USGS. Many states have been left with incomplete digital base data and quadrangle maps that are significantly out of date.

The USGS replacement for the traditional quadrangle map is the US Topo, which is currently only available in GeoPDF format. It includes data layers similar to the USGS topographic map, including an imagery base. For those areas that have US Topo coverage available, there are challenges in using them as base information for geologic mapping. For example, it is currently not possible to import a GeoPDF format file into ArcGIS software; it is also not possible to import the feature data into design software such as Illustrator and retain the critical georeferencing information, nor maintain the feature data as separated layers. Furthermore, while the roads, geographic names, and hydrographic features have been updated, the contour data layer for the majority of the US Topo maps has not been updated the appearance of the contours has changed significantly. Finally, as more and more high resolution Lidar topography becomes available, geologists will be faced with the problem that geology mapped using Lidar will not conform to USGS base data.

Because of the lack of availability and the outdated status of USGS topographic quadrangle base data products, coupled with data format and quality issues with the US Topo, it now starts to make sense to build custom basemaps for new geologic products. TIGER-based transportation and NHD hydrographic data, Lidar-produced contours and shaded relief images, and when available, a USGS scanned lettering feature layer from the original USGS topographic quadrangle maps can be integrated to produce a current and high quality base map for geologic mapping applications.